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Benefit-Sharing in Dam Projects on Shared Rivers

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Abstract

In recent years, the concept of benefit-sharing has been proposed as a means of fostering the cooperative use of international rivers. Most of the relevant literature focuses on opportunities for the generation of net benefits from cooperation; however, little attention has so far been paid to specific mechanisms for benefit-sharing applied to the specific case of dams on international rivers. This study therefore fills this gap and asks both what incentives can be offered to encourage benefit-sharing and what benefit-sharing mechanisms can be identified. As a first step, it develops a conceptual framework for benefit-sharing in dam projects. The second step is to test this framework at existing dams on the Rivers Senegal, Columbia, Orange-Senqu, Nile and Zambezi and to explore the benefit-sharing mechanisms used by undertaking an extensive review of the literature. As its third step it analyses factors that influence benefit-sharing on the basis of a review of the literature and the insights gained from the cases analysed.

The paper finds that the opportunities for deriving benefits from cooperation depend on the alignment of hydrological and political boundaries and the location of the dam in relation to them (hydro-political constellations) and on the aims and external effects of the individual dam. Incentives to cooperate on dams on shared rivers exist if: (i) cooperation will enable economic or financial limits to unilateral action to be overcome (Senegal); (ii) altering the design of a dam upstream will increase aggregate net benefits (Columbia); (iii) locating a dam upstream will increase aggregate net benefits (Orange-Senqu); (iv) compensating for negative externalities upstream will preclude conflict (Nile); and (v) a joint dam on a border river will produce mutual benefits (Zambezi). The case studies show that various benefit-sharing mechanisms are possible: (A) costs are shared in relation to benefits where dams are jointly owned (Senegal, Zambezi); (B) the party altering its unilateral dam design is compensated for any losses it incurs as a result of this alteration and net benefits of cooperation are shared (Columbia); and (C) the downstream state convinces the upstream state to build a dam, covers the cost and shares the net benefits derived from the dam (Orange-Senqu). The study further shows how political and institutional factors and the process influence the likelihood of the benefits of dams on shared rivers being shared. It also indicates that the neglect of negative environmental and social concern may lead to conflict and lengthy renegotiations at a later stage. These initial findings may provide guidance for riparian states engaged in and donors facilitating negotiations on dam projects on international rivers. From a scientific point of view, the typology developed should be tested further in additional case studies.

Key words: international rivers, dams, hydropower, benefits, costs, externalities, benefit-sharing mechanisms

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Abbreviations

ADB	Asian Development Bank
AfDB	African Development Bank
BCM	billion cubic metres
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
CAADP	Comprehensive Africa Agriculture Development Programme
CAN$	Canadian dollars
CAPCO	Central African Power Corporation
ESKOM	Elektrisiteitsvoorsieningskommissie (South African electricity supply company)
FAO	Food and Agricultural Organization of the UN
GDP	gross domestic product
GHG	Greenhouse gases
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWh	gigawatt per hour
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IHA	International Hydropower Association
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
IWMI	International Water Management Institute
KfW	Kreditanstalt für Wiederaufbau
LHDA	Lesotho Highlands Development Authority
LHWC	Lesotho Highlands Water Commission
LHWP	Lesotho Highlands Water Project
MCM	million cubic metres
MW	Megawatt
NEPAD	New Partnership for Africa's Development
OMVS	Organisation pour la Mise en Valeur du fleuve Sénégal
OVTS	Orange-Vaal Transfer Scheme
RSA	Republic of South Africa
SADC	Southern African Development Community
SOGED	Société de Gestion et d'Exploitation du Barrage de Diama
SOGEM	Société de Gestion et de l'Energie de Manantali
SSA	sub-Saharan Africa
TCTA	Trans-Caledon Tunnel Authority
TWh	Terrawatt per hour
UNECE	United Nations Economic Commission for Europe
US$	US dollars
WCD	World Commission on Dams
WSSD	World Summit on Sustainable Development
ZRA	Zambezi River Authority

Introduction

The last decade has seen a debate on benefit-sharing on international rivers (Sadoff / Grey 2002, 2005; Klaphake 2005; Phillips et al. 2006; Dombrowsky 2009). The main idea of the concept of benefit-sharing is to move from sharing water to sharing the benefits the users gain from its use. In principle, dams may play an important role in benefit-sharing schemes; however, their role has yet to be systematically explored. This is a serious deficit not least because of a renewed interest in multi-purpose dams in the context of development and climate change.

According to data published by the International Energy Agency (IEA 2010; 2011), only 33 per cent of the world's hydropower potential has been exploited. In this respect, sub-Saharan Africa (SSA) lags far behind Asia (which exploits 22 per cent), South America (33 per cent), North Africa (69 per cent), Europe (75 per cent) and Australia (49 per cent): Africa uses only 7 or 8 per cent of its gross potential generating capacity (its economically feasible potential being around 1,000 TWh/year). As experts of Frost and Sullivan suggest is the current installed capacity low. In Angola, Cameroon, DR Congo, Ethiopia, Gabon and Madagascar, for instance, averages between 2 and 4 per cent; Mozambique exploits 17 per cent of its potential, Nigeria 7 per cent, South Africa 20 per cent and Zambia 29 per cent.

The low rate of exploitation of hydropower potential in developing countries corresponds to a low rate of electrification, which is below the world average, with the SSA countries again the laggards. In 2009, 1.3 billion people, or around 20 per cent of the world population, did not have access to electricity (even though access to electricity was one of the targets set at the World Summit on Sustainable Development held in Johannesburg in 2002) and, globally, almost 2.7 billion people (about 40 per cent) continue to rely on biomass for cooking and heating. More than 95 per cent of them live either in SSA or developing Asia, 84 per cent in rural areas (IEA 2011). It is assumed that renewable energies, including photovoltaic, wind, biomass and hydropower, can play a role in electrification. According to World Bank estimates, Africa must develop an additional 7,000 megawatts (MW) of new electricity generation capacity per year in addition to implementing rural electrification programmes if undersupply is to be overcome; half of this 7,000 MW is to come from multi-purpose dams.[1]

Estimates in connection with the *Collaborative Programme of ADB, FAO, IFAD, IWMI and the World Bank* (2007) suggest that SSA also has considerable as yet undeveloped irrigable land and that agricultural water remains underdeveloped. In SSA, only five per cent of the cultivated land is irrigated (in North Africa the figure is 40 per cent) (World Bank 2007, 9). The *Collaborative Programme* points to the significant potential for expansion, for improving the productivity of the five million irrigated hectares and for bringing back into production the two million hectares of land that has been equipped with irrigation infrastructure but is currently unused (2007, xii). The New Partnership for Africa's Development (NEPAD) assumes that *"agriculture will provide the engine for growth in Africa",* and the Comprehensive Africa Agriculture Development Programme (CAADP*)* refers to the need *"to upgrade and rehabilitate existing large-scale irrigation schemes,*

1 http://siteresources.worldbank.org/INTAFRICA/Resources/aicd_overview_english_no-embargo.pdf (p. 6), accessed 28 Feb. 2012.

and to develop new ones" (Africa Recovery 2004). Multi-purpose dams are one way to develop both hydropower and water supply for irrigation.[2]

Dams may also play a role in climate change mitigation and adaptation. Hydropower is recognized as one of the "advanced, cleaner, more efficient, affordable and cost-effective energy technologies" (WSSD 2002) and as one of the best-developed non-fossil forms of electricity production.[3] Furthermore, hydrological variability is expected to increase in the course of climate change (IPCC 2008). Dams can buffer flows and play a positive role in the management of hydrological variability and in adaptation to climate change.

Given that most large rivers are shared by several countries, many of these new multi-purpose dams will be built on transboundary rivers. Benefit-sharing can be seen as a means of ensuring this is done in a cooperative manner and conflicts over water or its use are avoided. Benefit-sharing can prevent conflicts by focusing on the sharing of the benefits from a transboundary river rather than the mere sharing of the water itself (Sadoff / Grey 2002), and a transboundary approach to the selection of dam sites promises higher rates of return on investments if dams are constructed in *optimal* locations (where, for example, evaporation rates are low owing to a reduced reservoir surface area or a high altitude, or where storage volumes and river heads are high because dams are located in steep valleys). Benefit-sharing can be seen as the translation into practice of international water law, and specifically the principles of equitable and reasonable utilization, and of the absence of harm, which the international and regional conventions emphasize.[4]

Against this background, the Concept Note on *Transboundary Water Resources Management in Africa* issued by the German Federal Ministry for Economic Cooperation and Development (BMZ 2011) envisages "the preparation and financing of relevant regionally coordinated investments and the creation of financial mechanisms," and refers to *benefit-sharing* as one criterion for the prioritization of support for regional projects.

However, there is no denying that dams are among the most controversial infrastructure projects because of their significant environmental and social impacts (WCD 2000a). They interrupt river flows, change a river's course, a river's sedimentation regime and water quality, to mention but a few of their impacts (McCartney 2009). They often entail the acquisition of land and, therefore, the physical relocation and displacement of people. If such impacts are not adequately addressed, some already vulnerable populations are likely to be further impoverished, which will undermine development objectives (World Bank 2001).

The overall objective of this study is to analyse the essential elements and content of the benefit-sharing concept and its applicability to *dams* on shared rivers, given the impor-

2 However, dams are no solution on their own: they are just one of several options – for water supply and for electricity generation.

3 While dams may produce lower carbon emissions than fossil energy sources, they may emit other greenhouse gases (GHG), such as methane. The precise GHG balance depends on the setting and on whether the reservoirs were cleared of vegetation prior to initial flooding. Further, reservoirs in the tropics and subtropics release more GHGs than those in cold climates (Fearnside 2004; Chanudet et al. 2011).

4 See the UN Convention on the Law of the Non-Navigational Uses of International Watercourses (1997, not yet ratified), the Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992) and the Revised Protocol on Shared Watercourse Systems in the Southern African Development Community (2000).

tance of these infrastructure projects and their highly controversial nature. However, we acknowledge (1) that benefit-sharing is a wide-ranging topic, of which dam development is just one component, and (2) that the generation of a 'broad basket' of possible benefits increases the chances of setting up successful benefit-sharing schemes.

Given our focus on dams, we will consider the following questions at some length:

- What do we mean by benefit-sharing, and what are the peculiarities of applying benefit-sharing to *dams* on shared rivers?
- Which types of benefit-sharing mechanisms are applicable to dams, how do they differ, and where can they be found in practice?
- What political and institutional environment is conducive to the adoption of a benefit-sharing approach to dams?

The study is based on a review of the conceptual literature on benefit-sharing and of empirical cases, and develops the concept further by considering its applicability to single and multi-purpose dams on shared rivers (Chapter 1). Selected case studies illustrate the empirical relevance of the benefit-sharing concept (Chapter 2). The study then looks beyond a mere economic approach and describes conditions that facilitate and hamper the introduction of benefit-sharing arrangements (Chapter 3), and finally presents general conclusions and recommendations for development cooperation (Chapter 4).

1 Conceptualizing benefit-sharing on dams on international rivers

1.1 The concept of benefit-sharing on international rivers

The concept of benefit-sharing in the context of shared rivers entails a change from the mere volumetric allocation of water to the allocation of the benefits gained from the use of the river (Sadoff / Grey 2002; 2005; Klaphake 2005; Phillips et al. 2006; Dombrowsky 2009). The prospect of potentially gaining higher benefits by cooperating rather by than maintaining the status quo or by taking unilateral action encourages states to cooperate with each other in their use of shared rivers.

The concept suggests that countries can turn the perceived zero-sum game of water allocation, i. e. allocating more water to country A results in less water for country B, into a positive-sum game, i. e. a win-win situation in which all riparian countries are better off with cooperation than without (Biswas 1999; Giordano / Wolf 2003). This can be achieved by viewing the use of water from an economic perspective: rather than conceptualizing water use in quantitative terms, states should conceive of the river as a productive resource and attempt to increase and ideally maximize the economic benefits from its use and so to share them that all parties are better off than they were with the status quo ante.[5]

5 Maximizing the economic benefits derived from a river may lead to a situation in which it is used at the expense of the environment and aquatic ecosystems or vulnerable social groups. This is not what is advocated here: we argue in the following that any development activity should avoid or fully compensate environmentally and socially negative effects.

The notion of benefit-sharing in the use of shared rivers has been advanced by Sadoff and Grey (2002) among others. They define benefit-sharing as 'any action designed to change the allocation of costs and benefits associated with cooperation' (Sadoff / Grey 2005). In doing so, they distinguish four categories of benefits through which cooperating states can produce win-win situations (Sadoff / Grey 2002):

- benefits to the river: improve the ecological sustainability of the watershed;
- benefits from the river: water-related economic benefits by developing irrigation, generating hydropower, improving flood control or enhancing navigation;
- benefits due to reduced costs because of the river: reduction in political conflict and associated costs of conflict, when countries shift the policy focus from dispute to cooperation and development;
- benefits beyond the river: improved regional infrastructure, markets and trade ultimately resulting from benefits derived because of the river (Sadoff / Grey 2002, 393, Table 1).

Similarly, Phillips et al. (2006) argue that benefits can be generated in the economic, the environmental or in the security arenas and that activities in these various spheres may have spill-over effects. They propose to identify security, economic and environmental drivers in international river basins and, on that basis, opportunities for development at various levels (household, sub-national, national, regional, global) within each of these spheres.

Building upon these approaches, a concept paper on benefit-sharing and transboundary water management by the Southern African Development Community (SADC) visualizes this idea as a benefit-sharing wheel of eight categories of benefits: economic (i. e. economic growth through enhanced economic activity and trade); environmental (i. e. conservation to protect the waters of the basin); agricultural (i. e. enhanced agricultural production and trade in agricultural goods); social (i. e. reduction in poverty); political (i. e. enhanced political stability in the basin); hydrological (i. e. secured seasonal flow regimes); physical (i. e. negotiated changes to the physical landscape of the basin, such as through dams); and commercial (i. e. enhanced trade in and outside the basin) (SADC s. a.). However, while it is certainly useful to distinguish areas in which action can be taken and benefits can be created, from an economic point of view it is more common to confine the types of benefits to the economic, environmental, social and political arenas. For instance, increased productivity or trade in the agricultural sector would usually be regarded an economic benefit.

The benefit categories developed by Sadoff and Grey, Phillips et al. (2006) and SADC can serve as a starting point for *benefit generation*. They can also contribute to a deeper understanding of the range of sectors that can be included in generating benefits from cooperation and of the possible size of the "basket of benefits" (Phillips et al. 2006).

Going beyond benefit generation, Dombrowsky (2009; 2010a; 2010b) seeks to determine what incentives each of the riparian states involved has to negotiate and enlarge the basket of benefits and how riparians might distribute or *share* costs and benefits. To that end, she argues that it is useful to analyse the benefits and the potential negative and positive external effects of actual or planned water uses by individual states. The advantage of this approach is that it shows directly how cooperation alters the payoffs for each participating state compared to the status quo or unilateral action. This can then be used as a basis for

identifying a benefit-sharing mechanism which so changes the allocation of costs and benefits that every state will be better off compared to the status quo.

In the following, this approach will be applied to dams, and various kinds of benefits and external effects associated with dams will be analysed.

1.2 Benefits and external effects associated with dams

Our starting point for thoughts on benefit-sharing in the context of dams on shared rivers is the interest of individual basin states in developing their water resources for the benefit of their national economies. That interest may extend to energy production, the expansion of irrigated agriculture to meet food and energy security needs, the mitigation of hazardous floods and the improved navigability of rivers to enable trade potential to be tapped (see Table 1).

However, the generation of benefits through the construction of a dam in one country may have external effects both on local populations and on other countries. Such "external effects" or "externalities" occur when the use of water by one agent directly affects the use of water by another, and when these effects are not "mediated by prices" (Mas-Collel et al. 1995, 52), i. e. when they are not reflected in the cost-benefit calculus of the agent causing them. In the case of transboundary externalities, an upstream dam may, for instance, produce negative externalities downstream by reducing downstream water flow for irrigation, navigation or drinking water supply, or by increasing peak floods. Conversely, the upstream dam may also produce positive externalities downstream when the upstream dam improves flood protection downstream. However, the construction of a dam downstream may also produce a negative externality upstream by extending the reservoir across the border into the upstream state, where it inundates land on its territory. Thus gaining benefits

Table 1: Externalities of upstream dams in a downstream country

Benefits to upstream state A from a single or multi-purpose dam	Externalities in downstream state B
Hydroelectricity	(-) changed flow and sedimentation regime (-) peak flows (-) seasonal imbalance
Flood control	(-) changed flow and sedimentation regime (-) peak flows (+) regularized flow
Irrigation / drinking water	(-) changed flow and sedimentation regime (-) peak flows (-) seasonal imbalance (-) high to low water extractions (+) regularized flow
Improved navigability	(+) increased trade

Source: authors' own compilation

from a dam on the territory of one riparian country may have negative or positive external effects on other riparian countries. On a transboundary river (i. e. a river crossing an international border) these effects may occur downstream or upstream; on rivers forming state borders they tend to be more reciprocal (Dombrowsky 2007; 2010a; 2010b).

Table 1 explores potential benefits of building a dam in upstream state A and potential associated positive and negative externalities in downstream state B in greater detail.

Multi-purpose dams combine the externalities of single-purpose projects.

1.3 Hydro-political constellations and incentive structures for negotiations on sharing the benefits of dams

It will be clear from the above that the opportunities and incentives for cooperation on dams on shared rivers and the content and applicability of benefit-sharing mechanisms depend on the following factors:

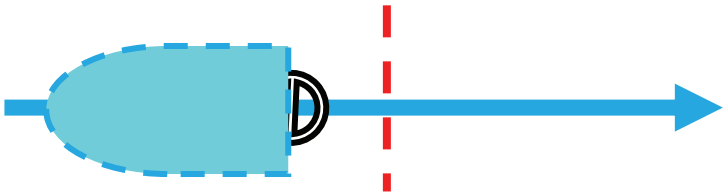
- The location of a dam on a shared river (hydro-political constellation). The defining element in the location of a dam is the relationship between the river and the national border. Two types of river-border relationships can be distinguished: (i) a transboundary river crosses an international border from the upstream country to the downstream country, the dam being located in either the upstream or the downstream country or on the border itself; (ii) the river forms the international border, the dam being located in both riparian countries.
- The purpose(s) of a dam on a shared river is (are) to achieve national (or sub-national) development objectives.
- Each state's specific interest in cooperation.

The hydro-political constellation and the purpose(s) therefore determine a dam's benefit, cost and externality streams. In the following, the study identifies typical constellations and, for each constellation, potential reasons and incentives for states to cooperate. In doing so, it initially conceptualizes states as unitary actors. This, however, is an abstraction for analytical reasons in order to understand the incentive structure at the international level. This does not imply that we suggest that states are unitary actors. To the contrary, international negotiations have to be conceptualized as two-level games (Putnam 1988): at the international level, state representatives negotiate international agreements that seek to generate net benefits for the country as a whole. At the national and sub-national level, the political process determines whether a respective international agreement will be ratified. Depending on the opportunities of affected population to voice their concerns, this national level process may – and we argue that it should – involve negotiations on the compensation of and benefit-sharing with those who are negatively affected by the international agreement.

Hydro-political constellation (1): a dam on a transboundary river – externalities downstream

The dam is located in upstream state A and produces positive and/or negative externalities in downstream state B (Figure 1).

Figure 1: Hydro-political constellation (1): a dam on a transboundary river in upstream state A with externalities in downstream state B



Source: Author's own compilation

The possible reasons for cooperating in this constellation include:

(i) *Financial or economic constraints on unilateral action*. Where unilateral action is subject to financial constraints, a state lacks the financial resources and/or technical capacity needed to build the dam alone, although it would be economically viable, and therefore asks co-riparian countries to contribute towards its cost and offers to share the benefits generated by the dam (as in the case of the **River Senegal,** see Section 2.1). Where unilateral action is subject to economic constraints, the project does not make economic sense for the upstream state on its own. An example would be an upstream dam the cost of which would exceed benefits within upstream country A. If the dam generates positive externalities for the downstream state (by regulating flows, for example), the project may become economically viable if the downstream state contributes towards the cost of the project. In this case, the project is rational only collectively, not unilaterally, since it pays off only if the benefits to all riparians are considered in the cost-benefit analysis and if they all contribute to the project costs, e. g. in proportion to the benefits they will derive from the project (for a more detailed explanation, see Dombrowsky 2009).

(ii) *Altered dam design increases aggregate net benefits*. An altered, jointly agreed dam design that takes external effects into account increases overall aggregate net benefits at basin level. The downstream state participates in the establishment of an upstream project to increase the basin-wide benefits of the project compared with the upstream state's unilateral alternative. This is possible if the alteration of the project increases aggregate net benefits. However, the altered design typically leaves the upstream country worse off (otherwise, the upstream state would have pursued this alternative from the beginning). In that case, the downstream country will approach the upstream country and ask for an alteration of the dam design and compensate it for any consequent losses (as in the case of the **Columbia River,** see Section 2.2). The remaining benefits of cooperation are then shared (for a more detailed explanation, see Dombrowsky 2009).

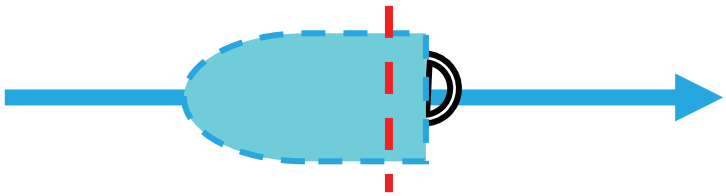
(iii) *The downstream country wants to build a dam on the territory of an upstream country.* This is the case, for example, if the dam site is more favourable for the achievement of the downstream country's national objectives than an alternative on its own territory in terms of, say, flood control (an example being Iraq's 1946 agreement with Turkey to build a dam on Turkish territory). Locating the dam in another state thus produces higher aggregate net benefits than a project alternative within national boundaries. The downstream country at least contributes to the cost of financing the investment and of operating the dam? The upstream country has an incentive to cooperate if it derives net benefits from the project (as in the case of the **Lesotho High-**

lands Water Project, see Section 2.3). While the upstream state is interested in building a dam in case (ii), it is the downstream state that is interested in doing so in case (iii).

Hydro-political constellation (2): a dam on a transboundary river – externalities upstream

The dam is located in the downstream state close to the international border, which causes externalities in the upstream state in the form of flooding.

Figure 2: Hydro-political constellation (2): a dam on a transboundary river in downstream state B with externalities in state A



Source: Author's own compilation

Possible reasons for cooperation in this constellation include:

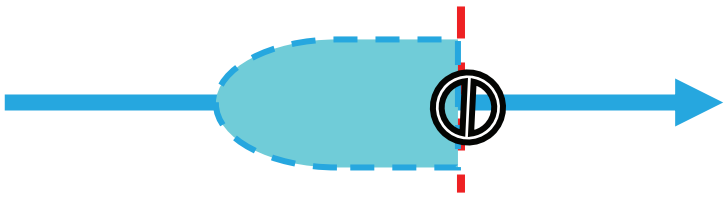
(i) *The downstream country wishes to maintain good-neighbourly relations*. It therefore compensates the upstream state for damage and shares the benefits of the project with it (e. g. **Aswan High Dam,** see Section 2.4). As will be explained below, the construction of the Aswan High Dam entailed cooperation under an international treaty that provided, among other things, for a single compensatory payment for flooding upstream. However, it is questionable whether this was sufficient to offset damage caused by the reservoir upstream (in which case, it would not be reasonable to speak of benefit-sharing).

(ii) *The downstream country wishes to avoid negative externalities* affecting the upstream country (e.g. Bui Dam, Ghana). As shown below, an international dimension was entirely avoided in the Bui case, there therefore being no benefit-sharing in the end, nor any damage upstream.

Hydro-political constellation (3): a dam on a border formed by a transboundary river

The dam is located where a river flows from state A to state B.

Figure 3: Hydro-political constellation (3): a dam on a border crossed by a transboundary river



Source: Author's own compilation

The reason for cooperation in this constellation is:

— *Benefits can be gained only though cooperation, but the externalities are asymmetrical*. An agreement is required to build on the border between upstream and downstream states. The cost of building the dam is shared according to the allocation of benefits. In addition, the asymmetrical externalities can be compensated for with a side-payment by downstream state B to upstream state A or vice versa. Examples are the 'friendship dams' on the Turkish-Syrian and Turkish-Bulgarian borders (not included in the study).

Whether and how state B compensates state A or vice versa, and what benefit-sharing mechanism is created, depends on the externalities and the incentive structure. This case represents an intermediate constellation between constellations 1 and 2, because territory of the upstream state is flooded and the downstream state may suffer the effects of upstream water storage and/or release. However, unlike the states in constellations 1 and 2, those in constellation 3 cannot act unilaterally.

Hydro-political constellation (4): a dam on a border river

The dam is located on a border-forming river. Externalities will therefore affect both states.

Figure 4: Hydro-political constellation (4): a dam on a border river

Source: Author's own compilation

The reason for cooperation in this constellation is:

— *Benefits can be exploited only through cooperation, but the externalities are symmetrical*. An agreement is required to build the dam on a river which forms the border between the riparian states. Benefits can therefore be gained only through cooperation, and benefits and externalities are in principle symmetrical. The cost of building the dam is shared according to the allocation of benefits (e. g. the **Itaipu and Kariba Dams**; see Section 2.5).

1.4 Negotiating benefit-sharing mechanisms

The states then enter into negotiations to "internalize" the external effects in a comprehensive cost-benefit calculus. In the process of internalizing the externalities, negative externalities are turned into costs and positive externalities into benefits. Ideally, all related costs (including capital, operating and maintenance, opportunity and external costs) and all related benefit streams (including direct and indirect use values, positive externalities and intrinsic values) are taken into account in the sharing of the benefits of dams (see, for

example, Rogers et al. 2002) and all parties affected (including local population) have a seat or are represented at the table.

The first step, therefore, is for the negotiating parties to determine whether cooperation will produce net benefits and so whether it has the potential to make all the various parties better off compared with the status quo or unilateral action. This is the case if the net benefits of cooperation minus the net benefits of no or unilateral action are positive. Net benefits are the sum of all benefit categories minus the sum of all cost categories.

As their second step, the parties have to determine how cooperation will affect each party's cost-benefit calculus. Given that individual parties may be made worse off by cooperation compared with no or unilateral action, it may be helpful to use side-payments and issue-linkages during the negotiations (Klaphake 2005; Dinar 2006; Dombrowsky 2009; 2010a; 2010b). A side-payment is monetary compensation for losses incurred by one party as part of an overall deal vis-à-vis no or unilateral action made by those who gain from cooperation. Thereby, the negotiating partners will make sure that nobody is worse off after the deal than before it. Issues are linked when separate areas of negotiation are discussed simultaneously with a view to a joint settlement being reached (on, say, water and security or trade). They can be understood as side-payments in kind, the partners coming to a quid pro quo arrangement by linking issues, rather than making a monetary side-payment. Issue-linkage has the advantage of avoiding the loss of face that might be seen to be associated with a side-payment (see, for example, Mäler 1990).

However, as the definition of benefit-sharing implies that all affected parties will be better off than they were before, not every side-payment or issue-linkage necessarily constitutes a form of benefit-sharing *per se*. A side-payment that compensates only for losses, but does not make the party better off compared with the status quo would not be considered benefit-sharing. For example, a one-time monetary payment by state A to state B for damages caused in B by a dam in A may not be considered benefit-sharing if the payment does not make state B better off compared to the situation without the dam in place.

After compensating for potential losses incurred by individual negotiating partners, the parties can share the net benefits of cooperation. One way is to split the net benefits of cooperation equally, unless there are good reasons for unequal splitting.

Benefit-sharing is easiest if all cost and benefit streams associated with the dam are quantified in monetary terms. However, environmental and social costs in particular are not usually expressed in market prices and their monetization can be methodologically complex (as well as time-consuming and costly) (see, for example, Garrod / Willis 1999). The results are often disputed and it is also disputed in what way negative effects can be adequately compensated. An alternative is to describe in qualitative terms those costs and benefit streams that cannot easily be quantified. All the riparian states affected must ultimately perceive the project as beneficial – or at least acceptable – and as better than doing nothing or acting unilaterally.

Note that in practice the affected local population is typically not directly represented in international negotiations, but international negotiations should be conceived as two-level games. Therefore, full compensation of negative social and environmental effects requires governments negotiate with those affected and ensure that they are at least fully compensated or that they even enjoy a portion of the benefits of cooperation at the domestic level.

The examples in Chapter 2 will show that negative social and environmental effects are often not adequately addressed.

On the basis of the above description and more detailed analyses in Chapter 2 below, three types of benefit-sharing mechanisms can be distinguished:

(A) In the case of jointly owned infrastructure, costs are usually born in proportion to benefits gained (Rivers Senegal, Zambezi and Paraná).

(B) When the design of a unilateral project upstream is changed to increase aggregate net benefits, the party altering its dam design is compensated for any losses incurred as a result of the alteration (in the form of monetary compensation, for instance), and the net benefits of cooperation compared to unilateral action by the upstream country are shared (in monetary terms or in kind) (River Columbia);

(C) When a downstream country builds a dam upstream in order to increase aggregate net benefits, it can be expected to cover investment and external costs, with the upstream state participating in the benefits of the project and the two countries sharing the net benefits of the joint project compared to the downstream country's unilateral alternative (River Orange-Senqu).

In each case, the benefit-sharing mechanism consists of the combination of all the elements used to balance costs and benefits and may or may not include compensation.

2 Case studies

In the following we analyse a number of cases discussed in the literature in which negotiations on dams on international rivers took place, and consider whether a benefit-sharing mechanism was involved and, if so, how it can be described. We explicitly also analyze whether negative social and environmental effects were included in the cost-benefit calculus. The cases discussed are dams on the Rivers Senegal, Columbia, Orange-Senqu, Nile and Zambezi, representing the different hydro-political constellations and incentive structures introduced in Chapter 1; this is followed by some notes on the River Paraná. Each case-study description includes an analysis of the international / transboundary benefit-sharing mechanism, of the manner in which the various states addressed environmental and social effects associated with the dams and of the institutional arrangements made.

2.1 Dams on the River Senegal: overcoming financial constraints of unilateral action

Project description and benefit-sharing mechanism

The development of the River Senegal is a regional project based on French colonial efforts to utilize the entire flow of the River Senegal for economic purposes. In 1963, having gaining their independence in 1960, all the basin states declared the Senegal to be an international river, thus taking a non-territorial view from the outset.

Transboundary cooperation on the River Senegal was introduced at a time when development was facing major difficulties (Yu 2011, 12–13):

- low GDP per capita (in constant US$ for the year 2000[6]): US$197 in Mali, US$377 in Mauritania, US$448 in Senegal;
- low agricultural productivity in Senegal, droughts in Mali and a lack of cheap electricity for the industrial sectors in Senegal and Mauritania; and
- frequent floods and droughts that hampered reliable agricultural production.

Mali, Mauritania and Senegal were all interested in increasing energy supply through hydropower development. In addition, Mauritania and Senegal wanted to expand irrigated agriculture to increase food security, and Mali had an interest in increasing the navigability of the River Senegal to ship natural resources to the Atlantic Ocean. After years of partly discordant negotiations and failed attempts to set up robust river management institutions, Mauritania, Mali and Senegal established the Organisation pour la Mise en Valeur du fleuve Sénégal (OMVS) in 1972.

The aim of the OMVS was to build two dams – Diama and Manantali – with a view to achieving food self-sufficiency by expanding irrigated agriculture, developing hydropower to increase the supply and lower the cost of electricity and enabling the river to be navigated to the Atlantic Ocean so that mineral resources might be exploited. The Diama Dam, located on the river delta in Senegal and Mauritania, was designed for flood control, irrigation and drinking water provision and to prevent seawater intrusion. The Manantali Dam, in Mali, was intended to enable hydropower to be generated, irrigation water to be stored and the river to be navigated. As none of the states was able to finance the dams on its own, the creation of the OMVS also provided a means of mobilizing the assistance of the international donor community. Both dams are owned by all three countries, which is quite exceptional on a transboundary river.

In view of their differing needs, the three states negotiated a cost-sharing key based on projected benefits. This *Clé de Répartition*, was adopted by the OMVS Council of Ministers in 1985 (Table 2).

Table 2: Cost-sharing key, adopted by the OMVS Council of Ministers in 1985

	Mauritania's share	Senegal's share	Mali's share
Cost allocation across sectors (energy, irrigation, navigation)	22.6 %	42.1 %	35.3 %
Allocation of benefits			
Energy	15 %	33 %	52 %
Irrigated agriculture (375,000 ha)	31 %	58 %	11 %
Navigation (access to Atlantic Ocean)	12 %	6 %	82 %

Source: Yu (2011, 19)

The Senegal case falls under hydro-political constellation (1), *a dam on a transboundary river – externalities downstream*. In terms of incentive structure, it can be considered a combination of case (i) – none of the riparians can finance a dam on its own – and case (iii) – locating the dam upstream increases aggregate net benefits. The benefit-sharing

6 Figures quoted from Yu (2011).

mechanism corresponds to type (A): joint infrastructure: costs borne in proportion to benefits received, however, as argued below social and environmental effects were not considered in the initial benefit-sharing scheme.

The two dams were built in the 1980s with a US$ 620 million loan from twelve donors (Yu 2011, 15). The Manantali Dam was completed in 1988, but without the power station. It did not begin to produce electricity until 2001, following a second donor package in 1997.

Social and environmental effects

Social and environmental effects were not addressed during the planning and construction phases. The dams led to deforestation, the resettlement of 12,000 people (for Manantali), the replacement of traditional recessional agriculture with irrigation agriculture, a reduction in fisheries and an increase in water-borne diseases. No provision was made for compensation mechanisms.

It was to be 1998 before the OMVS set up an Environmental Impact Mitigation and Monitoring Programme to address the environmental and social impacts of the Manantali and Diama Dams. This was financed from the resources of a 1997 Regional Hydropower Development Project set up by donors to improve hydroelectricity production and distribution.

In 2002, the OMVS countries signed a Water Charter, which added sustainability and environmental protection to the OMVS mandate. It requires an Environmental Action Plan, extends the membership of the Permanent Water Commission to include non-governmental stakeholders (farmers, fishermen's associations, NGOs, etc.) and defines mechanisms for reviewing new projects (Yu 2011, 21–23).

Institutional set-up

The OMVS is a quadrilateral river basin organization (Guinea joined in 2005) with four permanent organs: the Conference of Heads of State and Government, the Council of Ministers, the High Commission and the Permanent Water Commission.

The authorities operating the Diama and Manantali Dams, the Société de Gestion et d'Exploitation du Barrage de Diama (SOGED) and the Société de Gestion de l'Energie de Manantali (SOGEM), were founded in 1997 under the Convention portant création de l'agence de gestion de l'exploitation de Diama and the Convention portant création de l'agence de gestion de l'énergie de Manantali. Their task is to operate, maintain and repair the dams and associated structures. SOGEM and SOGED each consist of a Council of Ministers, an Administration Council and a Directorate-General. SOGEM's budget is funded from the sale of energy, SOGED from fees for the use of water for irrigation and as drinking water. The member governments provide additional funding. The three member states are equally represented in SOGEM and SOGED.

Under donor pressure, the operation of Manantali was handed over to the South African utility ESKOM after an international call for tenders supervised by SOGEM. ESKOM's task is to operate and maintain energy production facilities and transmission lines, to distribute energy from Manantali to all three member states and to collect fees and hand them

over to SOGEM. SOGEM determines electricity prices in agreement with the Council of Ministers (Kirschke 2010, 13–17).

Lessons learnt

The OMVS presents a mixed picture. The *Clé de Répartition* can be considered a success to the extent that the countries agreed on expected benefits from cooperation and to share costs in relation to expected benefit streams. The OMVS is jointly managed, and the dams are jointly owned through the OMVS which is quite exceptional for dams on transboundary rivers. This, however, has enabled conflicts which related to the use of the waters of the River Senegal and to the construction of dams, to be managed in a constructive manner.

Politically, the organization is therefore deemed to be a success. This is partly due to the definitions laid down by the member countries for crucial parts of the infrastructure cooperation in two conventions: the *Convention Concerning the Legal Status of Jointly-Owned Structures* (1978) and the *Convention Concerning the Financing of Jointly-Owned Structures* (1982) (Ayibotele s. a., 7):

— all structures are the joint property of the OMVS member states;
— investment costs and operating expenses are shared by the owners according to the benefits they derive from the structures; and
— each co-owner guarantees repayment of the loans extended to the OMVS by the international donor community for the construction of the relevant infrastructure.

The OMVS was preceded by a history of cooperation in the Senegal Basin, most importantly under the Bamako Convention,[7] signed by Guinea, Mauritania, Senegal and Mali in 1963. The Convention accords the River Senegal international status (Ayibotele s. a., 5). This is pre-dated by French colonial plans for the economic exploitation of the whole of the Senegal River Basin.

However, a range of negative factors have impeded the OMVS (KfW s. a.; Kirschke 2010, 16–18; Yu 2011, 20–23; Kipping 2005):

First, the funds provided by the member states proved insufficient, making continued donor contributions necessary. ESKOM is also suffering from the bad paying habits of its customers. This is also why SOGEM is inadequately funded. SOGED, funded from the sale of water, suffers from similar problems.

Second, soaring land prices due to infrastructure development led to internal conflict in Mauritania, which spilled over into a border war between Mauritania and Senegal in 1989–1991.

Third, the OMVS is heavily dependent on donor support. Both dams were built with a loan from the international donor community, and the 1997 Regional Hydropower Development Project, which was to revive the plans for electricity production and distribution, was also established with donor support. This was deemed necessary, because

7 Convention de Bamako Rélative à l'Aménagement général du Bassin du Fleuve Sénégal.

— the economic benefits of expanding irrigated agriculture and producing electricity that were envisaged by the OMVS were not achieved. In addition, with many local farmers preferring the less risky and less capital-intensive flood recessional agriculture, the countries agreed to change the dam management regime to allow more traditional agriculture. The additional release included a trade-off calculation between additional water releases and the remaining hydropower capacity;
— the principle of equal representation in all the OMVS institutions, though politically useful, led to institutional paralysis since it precluded dynamic responses to any social and environmental impacts that ensued; and
— the focus on benefits at national level (national economic development), at the expense of the people affected by the dams led to a severing of the link between national and local development.

A lack of regional funding and dependence on donor finance ultimately proved problematic and raises the question of ownership. Dam construction and environmental protection measures are essentially donor-initiated and donor-funded. While the various countries have an interest in creating and maintaining electricity infrastructure, institutional management and local funding appear to be the key issues for the management of the OMVS.

Sources: Yu (2011, 12–26); KfW (s. a.); AfDB (1988); Kirschke (2010). For further information see Alam, Dione and Jeffrey (2009) and Kipping (2005).

2.2 Dams on the Columbia River: altered dam design increases aggregate net benefits

Project description and benefit-sharing mechanism

The Columbia River is shared by Canada and the United States. Plans by upstream Canada to utilize the Kootenay and Columbia Rivers for hydropower production would have threatened hydroelectric power generation in the United States at the Bonneville, Grand Coulee and John Day Dams. An additional threat to downstream hydropower was the frequent flooding as the Columbia and the Kootenay Rivers spilled across the border into the United States. The United States therefore tried to induce Canada to change its upstream water use plans to safeguard and improve downstream hydropower production. Negotiations on these issues finally resulted in the *Treaty Relating to Cooperative Development of the Water Resources of the Columbia River Basin*, signed in 1961 and ratified in 1964.[8]

Under the Columbia River Treaty, Canada was required to build three large storage dams – Duncan, Keenleyside and Mica, all built during the 1960s and 1970s – for flood protection in the United States and power generation in Canada and the United States. In return for providing flood control and the additional hydropower benefits generated downstream thanks to its reservoirs, Canada received from the United States in advance half of the value of the downstream flood protection and gained the right to half of the additional electricity generated downstream in the United States (Columbia River Treaty, Articles II-VIII).

8 For a history of the negotiations leading to the conclusion of the Columbia River Treaty see Muckleston (s. a., 22–30).

To operationalize the provision of hydropower, the Canadian province of British Columbia, which assumed responsibilities from the Canadian federal government under the Treaty, sold the electricity to US buyers *"on a 30-year contract for an upfront payment. The total of the upfront payment for flood control and electricity sales was sufficient to pay for all the Treaty projects in British Columbia […]. The electricity from that facility is the sole property of British Columbia Hydro, the province's power utility"* (Égré et al. 2002, 47).

Canada was thus required to build dams upstream to prevent flooding in the United States. In return, it was entitled to two forms of compensation over the 60-year life span of the Treaty:

— half of the additional electricity that the United States was able to generate at its existing Bonneville, Grand Coulee and John Day Dams downstream. British Columbia *"sold the first 30 years of its 'Entitlement' to a group of US utilities for $254.4 million"* (Yu 2008, 35); and

— *"one-half the value of the flood damage reduction the reservoirs in Canada would help to protect in the US floodplains"* (Yu 2008, 35).

This effectively financed the entire Canadian infrastructure required under the Columbia River Treaty.

The intention of the deal was to increase and share aggregate net benefits through an altered design of the dams planned upstream (case (ii) for hydro-political constellation (1)). However, Krutilla (1967, 194–195) argues that the reservoirs built under the Columbia River Treaty in fact turned out to be cheaper for Canada than unilateral alternatives. Conversely, the Treaty provisions proved to be more expensive for the United States than a domestic alternative. The Treaty therefore had a cost-saving effect for Canada, but proved costly for the United States. Hence, while the intention was to generate net benefits from cooperation as compared with Canada's unilateral alternative(s), it cannot be fully established whether the final result proved to be an effective benefit-sharing mechanism.

Social and environmental effects

The Canadian dams required the resettlement of 2,300 people. During the construction phase in the 1960s and 1970s, 60,000 hectares of land were flooded, indigenous archaeological and burial sites were submerged, and environmentally sensitive areas disappeared. At the time, there were no adequate mechanisms to compensate for these losses (Égré 2007, 48).

It was only in the early 1990s, shortly before the expiry of the 30-year period in which British Columbia sold its share of downstream electricity, which local communities and indigenous people in particular demanded changes to the sales system and a share of the benefits generated from electricity sales. In 1992, local government at the regional district level and tribal councils formed the Columbia Treaty Committee, which entered into negotiations with the province of British Columbia for a local benefit-sharing mechanism. The result was the setting-up of the Columbia Basin Trust (Égré 2007, 48).

Under the Trust arrangements, a Columbia Basin Management Plan was developed. The Trust was endowed with CAN$295 million from the province of British Columbia. This was equivalent to 5 per cent of the province's share of the downstream benefits. The funds

have been used to build power stations on the existing reservoirs and to purchase and expand generating capacity at the Waneta and Brilliant Dams. The power projects are designed to assist the region's economic development. The funds are also used for investment in non-power projects, such as business loans for basin residents. In addition, the province contributed CANS$2 million towards operating costs for the period 1991–2010 (Égré 2007, 48–49; Columbia Basin Trust website at http://www.cbt.org/Investments/?Power, accessed 3 Aug. 2011).

Institutional set-up

No river basin organizations were established under the Columbia River Treaty. However, the Treaty negotiations were institutionally complex: the province of British Columbia 'held veto power over conclusion of the [… Treaty] because within the Canadian federal system provinces have sovereignty over their natural resources and share in decision making when natural resources are involved' (Muckleston s. a., 29). On the Canadian side, this complicated the search for a consensus as the basis for negotiations with the US authorities (Muckleston s. a., 13, 29–30).

Unlike the Columbia River Treaty, the Columbia Basin Trust is governed by a board of twelve directors, who are nominated by the five regional districts in the Columbia River Basin, the Ktunaxa Nation Council and the province of British Columbia (Égré 2007, 49).

The Trust invests its capital and manages its assets. In cooperation with advisory committees of basin residents, the Trust uses its revenues to fund projects in the areas of 'environment; economic development; social; education and training; youth initiatives; arts, culture and heritage' (Égré 2007, 49).

Lessons learnt

It is not clear whether the Columbia River Treaty can be regarded as a success in benefit-sharing terms, given that, financially, Canada benefited more than the United States. According to the analysis by Krutilla (1967), the United States was in fact worse off than it would have been if it had adopted unilateral solutions and built additional hydropower capacity outside the Columbia River Basin.

Politically, the Treaty was made possible by a history of cooperation between the two countries before the Columbia River Treaty was signed and by the political will to find a permanent solution to the problem of managing transboundary rivers. Cooperation dates back to 1783, when a settlement was reached on navigational rights for citizens of the two countries. When economic expansion in the United States and Canada led to increased use of boundary waters, the two countries entered into negotiations on the Boundary Waters Treaty, which was signed in 1909, becoming the first treaty to standardize bilateral cooperation on boundary waters beyond a needs-based 'ad hoc' approach (Muckleston s. a., 22).

Apart from being able to look back on a long history of cooperation, the projects established under the Columbia River Treaty were managed so effectively that they led to substantial income generation for the Canadian project owners. This enabled the endowment of the Columbia Basin Trust. The coordinated efforts of local government and the people affected to obtain compensation for the social and environmental damage led to the active involvement of local communities in the creation of the Trust. Through its governing

structure, these communities are also directly involved in choosing the projects on which the funds will be spent.

The Columbia Basin Trust was established because of the neglect of the social impact at the time the Canadian reservoirs were built. The use of the revenues then needed to be renegotiated after the first phase of the Treaty with the population directly affected as local people forced the Canadian authorities to introduce a participatory mechanism through which people in the affected localities could have a say in the use of some of the income generated by the Canadian dams.

Sources: Columbia River Treaty (1961); Égré (2007); Égré et al. (2002); Muckleston (s. a.), Krutilla (1967)

2.3 Lesotho Highlands Water Project on the River Senqu-Orange: locating the project upstream increases aggregate net benefits

Project description and benefit-sharing mechanism

The earliest plans to harness the upper reaches of the River Orange-Senqu in Lesotho and to transport its water to South Africa were laid in the mid-1950s, when Lesotho was a British protectorate. Early negotiations failed over the sharing of the infrastructure costs and the price of delivering water. In the 1970s and 1980s, important domestic and international political issues jeopardized the realization of the scheme (e. g. South Africa's apartheid policy; territorial disputes between Lesotho and South Africa; South Africa's reservations about dependence on a foreign state for its water supply). The political climate in both countries changed towards the end of the 1980s, with the RSA adopting a friendly regional policy and Lesotho establishing a civil government.

The cooperation between the RSA and the government of the Kingdom of Lesotho in the Lesotho Highlands Water Project (LHWP) is one of the most far-reaching examples of water cooperation on the African continent. The physical core of the project is formed by the construction of a cascade of six dams, 200 km of tunnels and associated water infrastructure, including pumping stations and hydropower plants, on the upper reaches of the River Senqu (which becomes the River Orange in the RSA) on the territory of upstream Lesotho (a small land-locked, mountainous and water-rich kingdom). Once all three main phases of this multi-phase project are finalized in 2021, an expected 2,200 million cubic metres (MCM) of water will be transferred annually from the mountainous areas of Lesotho to South Africa. By 2002, only the first two phases – the construction of the two giant Katse (110 MW) and Mohale Dams[9] and the associated tunnels and diversion weirs – had been completed (1998 and 2002 respectively). The water-receiving region is the RSA's Gauteng Province, the country's industrial heartland, which already has to cope with serious water shortages. The project has enabled Lesotho to reduce its heavy reliance (about 90 per cent) on imports of South African energy by generating 2,000 GWh of hydroelectricity annually.

9 The construction of the Mashai Dam (166 MW) has not yet begun.

The two countries concluded that water originating from Lesotho's River Senqu which would otherwise flow down the River Senqu-Orange should be rerouted to South Africa's Gauteng region. For this, Lesotho is compensated with electricity it generates at the new dams on its territory. The LHWP treaty (1986) specifies the mechanisms for sharing the cooperative gains from joint development. South Africa bears the full cost of transferring water (including the cost of construction, operation and maintenance and of social and environmental mitigation measures), whether incurred directly by the RSA or initially financed by loans to the Government of Lesotho or the Lesotho Highlands Development Authority (LHDA) (debt servicing and cost-related payments are met by RSA). Lesotho, on the other hand, bears the hydropower cost component (about five percent of total LHWP costs). The RSA receives water while Lesotho retains the benefits of hydroelectricity production. The LHWP Treaty stipulates that South Africa shares with Lesotho, by means of royalty payments, the net benefit (56 per cent for Lesotho and 44 per cent for the RSA), "computed as the difference between the present value of the LHWP and similar alternative projects." Thus the RSA pays royalties to Lesotho equivalent to 56 per cent of the cost savings identified by proceeding with the LHWP (Yu 2002, 52).

Calculations of net benefits are based on the difference in the cost of two options: one project entirely in the RSA (unilateral option), the other based on cooperation between the RSA and Lesotho. The latter takes advantage of gravity and of less complex civil engineering than would be required to transfer the same amounts of water from the River Orange within the RSA. These cost savings formed the basis for determining the royalties paid to Lesotho (not for water, but rather for the cost saving due to the LWHP). The royalties comprise a *fixed component*, which is calculated on the basis of the difference in investment cost s between the LHWP and the unilateral option, the Orange-Vaal Transfer Scheme (OVTS), and a *variable component*, which reflects the differences in pumping, operating and maintenance costs, as compared with the OVTS.

In this case, downstream RSA approached upstream Lesotho with the idea of constructing a dam. The cost would be borne by the RSA, and Lesotho would have the benefit of hydropower, but it would suffer adverse environmental and social effects, for which it would, however, be compensated. Although the LHWP is a very special case in terms of water diversion, it is generally an example of case (iii) in hydro-political constellation (1), where the downstream state seeks to increase its net benefits by building a dam upstream. Benefit-sharing mechanism (C) applies where the downstream state builds a dam upstream to increase aggregate net benefits and meets the investment and external costs. The upstream state participates in the benefits of the project, and the two states share the net benefits of the joint project compared to the downstream state's unilateral alternative.

Institutional set-up

The bilateral arrangement agreed by South Africa and Lesotho is fairly complex, comprising not only financial and ownership arrangements, but also dispute settlement mechanisms, a bilateral organization (the Lesotho Highlands Water Commission, LHWC) made up of representatives of the two governments and two autonomous implementing agencies:

(i) the Lesotho Highlands Development Authority is mandated to capture water and transfer it to the RSA; to generate hydropower for Lesotho; to maintain agreed rates of

flow; and to ensure that local communities affected will be able to maintain a standard of living not inferior to pre-project conditions;

(ii) the Trans-Caledon Tunnel Authority (TCTA) in the RSA is mandated with the engineering, construction, operation and maintenance and is responsible for reimbursing the project costs and debt service (TCTA sells water to the RSA's Department of Water Affairs and Forestry on the basis of full cost recovery).

Social and environmental effects

The social and environmental effects were mainly confined to Lesotho, where the dam infrastructure is located. While South Africa financed the infrastructure and pays royalties, it was Lesotho that incurred the environmental and social losses, but for this it received compensation. Revenues from the project were paid into the Lesotho Highlands Revenue Fund, which was suspended shortly after its launch in 1996 owing to a number of problems, including intransparent mechanisms for project-funding and investments in projects that were not demand-driven and thus proved ineffective. In 1997, the Lesotho Fund for Community Development was established to ensure employment generation and poverty reduction. Public participation in how the funds are used has improved, but remains a challenge. However, for the current phase *"the key environmental and social impacts associated with the civil works of LHWP were assessed to be successfully mitigated"* (Yu 2011, 61–63).

Lessons learnt

The LHWP is an exceptional example of net benefits from cooperation compared with unilateral development, largely due to the RSA's willingness to share the benefits of cooperation fairly. The LHWP was made possible by the fundamental political changes which occurred in both countries in the late 1980s. However, the LHWP is also one of the most controversial transboundary water management projects because of its significant negative environmental impacts and its general failure to integrate local people and stakeholders. From the early 1990s, such national and international interest groups as environmental groups, human and social rights activists and church associations voiced objections to the project. In 1998, the LHDA and various interest groups in Lesotho signed a Memorandum of Understanding setting out rules for the involvement of interest groups in the LHWP and specifying the legal obligation of the state parties to safeguard the welfare of persons and communities affected. The LHWP administration and the interest groups agreed on Environmental Action Plans, which provided the framework for establishing mitigation, compensation, resettlement and development measures. This also shows that the project and the way it was operated continued to be disputed despite the compensation for negative social and environmental effects – and that monetary compensation may not always be perceived as equivalent to avoiding damage in the first place.

Sources: Yu (2011); Klaphake / Scheumann (2009); Égré (2007); Égré et al. (2002)

2.4 Aswan High Dam (Egypt, Sudan) on the River Nile: compensating for negative externalities upstream

Project description

In the Nile Basin Egypt is the downstream riparian, but also militarily, politically and economically the most powerful state in a basin of eleven riparian states since Sudan's partition. As Egypt is traditionally dependent on the Nile for its agriculture, it has always sought to secure its right to the Nile waters. Claims to the River Nile were codified in a treaty between Egypt and Britain in 1929 and in another treaty between Egypt and Sudan in 1959, under which the natural inflow was shared between two, among three riparian countries farthest downstream. The other, upper Nile riparian countries are not signatories to these treaties.

Egypt constructed the Aswan Dam in the 1960s to improve domestic flood protection and irrigated agriculture and to produce hydroelectric power for its post-independence industrialization. The Aswan Dam created a reservoir, Lake Nasser, 550km long and 5,250 km^2 in area. Given the size of Lake Nasser, the dam led to the flooding of parts of upstream Sudan, where the reservoir is known as Lake Nubia. Egypt therefore agreed to compensate Sudan. The compensation was specified in the 1959 *Agreement between the Republic of the Sudan and the United Arab Republic for the Full Utilization of the Nile Waters*. Paragraph 6 of the Second Chapter states, that Egypt will pay Sudan 15 million Egyptian Pounds 'as full compensation for the damage resulting to the Sudanese existing properties.' The compensation agreement did not include provisions for the resettlement of the Nubian population in Sudan.

The Second Chapter of the 1959 Agreement also 'allowed' Sudan to build the Roseires Dam on the Blue Nile and further river works in accordance with Sudan's rights to the Nile waters (Paragraph 2). The Second Chapter further specifies a volumetric allocation of water to Sudan and Egypt on the basis of the augmented water supply provided by the Aswan reservoir, Egypt's share being 55.5 billion cubic metres (BCM) per year, Sudan's 18.5 BCM, based on their 'acquired rights' and the 'net yield of the Nile after the full operation of the […] Reservoir' (Paragraph 4). The Aswan High Dam made it possible to increase the water allocated to the two countries, compared with the allocation specified in the 1929 agreement between Egypt and Britain acting on behalf of Sudan.

A benefit-sharing mechanism?

This case corresponds to hydro-political constellation (2), a dam on a transboundary river with externalities upstream. However, while some compensation was provided for flooding upstream and Sudan's overall Nile allocation was increased under the agreement, it is unclear whether the latter can be considered to make for benefit-sharing as this paper understands it, since it is unlikely that the compensation offsets the damage suffered by Sudan (including the cost of resettlement) and difficult to judge whether Sudan is better off overall than it was before the Aswan High Dam. Furthermore, the other Nile riparian countries were not party to the 1959 agreement and do not accept Egypt's and Sudan's claims to the natural inflow of Nile waters into Sudan for themselves.

Social and environmental effects[10]

The environmental impacts consisted in erosion and salinization of soils in the Nile Delta and water-borne diseases. As for resettlement, 100,000 to 120,000 Nubians on the Egyptian and Sudanese sides of the river had to be relocated, 50,000 in Egypt and 50,000 to 70,000 in Sudan. Scudder describes the resettlement on the Egyptian side as having proceeded in accordance with a 'commendable but non-participatory development plan' (Scudder 2003, 27). This plan provided for compensation and post-relocation development projects, including schools and medical facilities, agricultural land reclamation and the development of non-agricultural work opportunities. The Nubians were resettled as a group in the area around Kom Ombo, 45 km downstream from Aswan, where another group of Nubians had already been resettled in connection with an earlier dam.

Yet, because the resettlement was rushed and Nubian cultural features in the areas of housing and family organization, for example, were neglected, the first ten years after resettlement proved difficult, with high death rates in the first year and a government request for food assistance from the UN Food and Agriculture Organization and the World Food Programme in eight of the years between 1965 and 1975. It was only after the first decade that the situation improved markedly. Among other things, the people resettled were integrated into the economy of the Aswan province and Nubian representatives were elected to local political posts.

The resettlement programme in Sudan was planned with less consideration than in Egypt and included the resettlement of the Nubian population to semi-arid zones, where they had to cope with unfamiliar rainfall patterns and new diseases.

Institutional set-up

While no bilateral institutions are associated with the construction of the Aswan High Dam, there is a Permanent Joint Technical Committee on which both Egypt and Sudan are represented under the 1959 agreement.[11]

Lessons learnt

The downstream reservoir extension was covered by the 1959 bilateral agreement between Egypt and Sudan, which set out compensation levels and water rights based on the older 1929 agreement. The sharing of water rights between the two countries had therefore already been established. As the sharing of water forms the basis of benefit-sharing under both the 1929 and the 1959 agreement, benefit-sharing does not replace water-sharing. It can be argued that water is shared without consideration for the upstream countries' rights to Nile water. From a basin perspective, additional net benefits of cooperation might also be gained from moving storage capacity upstream to reduce evaporation losses and increase opportunities for hydropower generation (e. g. Whittington / McClelland 1992;

10 This section gives a brief summary of Scudder (2003, 11–30).

11 In 1999, the Nile Basin Initiative was launched with a view to enabling basin-wide cooperation on socio-economic development in the Nile River Basin.

Whittington et al. 2005).[12] A final evaluation of the mechanism for compensating for the flooding in Sudan caused by the Aswan High Dam will require further research.

Sources: Agreement between the Republic of the Sudan and the United Arab Republic for the Full Utilization of the Nile Waters; Scudder (2003)

2.5 Kariba Dam on the River Zambezi (Zambia, Zimbabwe) and notes on the Itaipu Dam on the Río Paraná (Brazil, Paraguay): symmetrical benefits of a dam on a border river

Project description and benefit-sharing mechanism

The Zambezi River Basin is one of the largest transboundary basins in Africa. It stretches across the territory of eight states, namely Angola, Zambia, Botswana, Namibia, Zimbabwe, Malawi, Tanzania and Mozambique. Cooperation began in the early 1950s, when the then Northern Rhodesia (Zambia) and Southern Rhodesia (Zimbabwe) were under colonial rule and united in a federation with Nyasaland (Malawi). The Federation engaged in a hydropower project because *"the copper mines of Zambia were experiencing electric power shortages and there was an urgent need for a large dependable source of cheap electric power. In addition, the fast developing industrial, agricultural and mining sectors of Southern Rhodesia were also suffering from a shortage of electric power"* (WCD 2000b, 133).

The key element of the project infrastructure is the Kariba Dam, which was built between 1953 and 1963 along a 760 km strip where the river now forms the border between Zambia and Zimbabwe. The dam has an active storage capacity of 186 BCM and two power stations with an installed capacity of 1,266 MW (600 MW in Zambia, 666 MW in Zimbabwe), which provide 34 per cent of the total electricity consumed in the two countries.

When the Federation ended in 1963, with Zambia gaining its independence in 1964 and Zimbabwe following in 1980, cooperation became an international issue in the true sense of the word. At that time, the project had yet to be completed, and the states had to negotiate on dam-operating procedures. In November 1963, Northern and Southern Rhodesia established the Central African Power Corporation (CAPCO) to complete the construction work and operate the system, including electricity generation and transmission. A Higher Authority for Power comprising two ministers from each country would control and coordinate CAPCO's activities. CAPCO was abolished in 1987, and the Zambezi River Authority (ZRA) was established in the same year. The change occurred because Zambia thought that CAPCO favoured Zimbabwe (Scudder 2005, 7).

The Kariba Dam is owned equally by the Governments of Zambia and Zimbabwe, its benefits and liabilities similarly being shared equally. It is operated by the ZRA.

12 In 2011, Ethiopia laid the foundation stone for a more than 5000 megawatts hydropower dam close to the Sudanese border, the so called Millennium or Grand Renaissance dam. In January 2012, a first meeting of an Ethiopian-Sudanese-Egyptian tripartite committee dealing with the dam's cross-border effects took place (http://grandmillenniumdam.net, accessed 26 March 2012).

The Kariba case thus falls into hydro-political constellation (4), a dam on a border river with benefit-sharing mechanism (A), where the cost of joint infrastructure is borne in proportion to benefits received.

Institutional set-up

The ZRA is a corporate body under parallel legislation enacted by the parliaments of Zambia and Zimbabwe "for the economic, industrial and social development of the two countries, the greatest possible benefit from the natural advantages offered by the waters of the Zambezi River and to improve and intensify the utilization of the waters for the production of energy and for any other purpose beneficial to the two countries" (ZRA 1987).

Hydropower generation and the transmission system have been designed to operate as a single entity with two national power stations. The system in each country supports the other to preclude blackouts and to stabilize voltage outputs and frequency. In addition, hydropower is generated at the Kariba Dam in conjunction with the thermal power stations in Zimbabwe and the Kafue Gorge power station in Zambia (Tumbare 2002).

The ZRA has a four-level policy and management structure comprising a Council of Ministers, a Board of Directors, a Chief Executive and three departments for operational functions. The ZRA's mandate is to maintain the dam's water level and to allocate water to the two national power utilities, the Kariba North Bank Company (Zambia) and the Zimbabwe Electricity Supply Authority. It finances its activities from the sale of water to the power utilities; revenues from these sales are typically in the order of US$10 million annually.

Social and environmental effects

> *"The pre-project planning document (1951) estimated the number of people to be resettled at 29,000. In the Kariba project document of 1955, there is little detail on the resettlement programme, except for a budget allocation of £4 million that was to be spent. (...) Later, a decision was made that each of the governments in Zambia and Zimbabwe would have responsibility for managing resettlement in their country. This decision meant that the resettlement programme was removed from the main project. The actual number of people to be resettled increased from 29,000 to 57,000. The budget for resettlement remained unchanged"* (WCD 2000b).

The Kariba Dam flooded the Zambezi valley upstream where the Tonga people lived on both sides of the river. They were to be resettled far away from the reservoir area where *"they had to build from scratch, clearing the bush and constructing huts. The people of the north and south banks were cut off completely from each other. … Many also lost highly productive alluvial fields on the edge of the Zambezi and had to take to dry land farming in the rugged foothills of the escarpment"* (Tremmel et al. 1995), in areas with poor soil for farming and limited access to water. While an international rescue activity (Operation Noah) took care of endangered species, the 50,700 Tonga found neither national nor international support.

Lessons learned

With regard to electricity demand in Zambia and Zimbabwe, interests are symmetrical, which contributed to the realization of the project. However, interests were not always in harmony. In the early planning stage, Northern Rhodesia favoured a project on its territory (the Kafue tributary), while Southern Rhodesia opted for the location subsequently chosen, Kariba, where the river forms the border between the two countries. To settle the Kariba-Kafue debate, the Federal government appointed a neutral party in 1953 to assess the two projects objectively. The Coyne report of December 1954 convinced the Federal government that the Kariba project should have preference over Kafue (WCD 2000b, 11).

The creation of the Kariba project therefore became possible because the Federal government overruled Northern Rhodesia. Cooperation between Zambia and Zimbabwe, already unsatisfactory under the Federal government, remained difficult, leading Zambia to press for the abolition of CAPCO and the creation of an alternative organization (ZRA) that had less executive power and was more closely supervised by the two governments.

The 1987 ZRA arrangement can be considered a relative success in terms of benefit-sharing at international level. It shows that benefit-sharing may be easier in border river arrangements with symmetrical interests than in a transboundary setting. However, distributing costs and benefits in a way perceived to be equitable by the various parties may still pose challenges. The project also came at the expense of the local population, which had to be resettled.

Box 1: Notes on the Itaipu Dam, Río Paraná

The Itaipu power station has an installed capacity of 14,000 MW and produces almost 100 percent of Paraguay's electricity and 25 percent of Brazil's. The dam and power station are located on the Río Paraná where it forms the border between Brazil and Paraguay. Feasibility studies on the hydroelectric potential of the Río Paraná had already been carried out in the 1940s and, after lengthy negotiations, they resulted in the Act of Iguaçu (1966). In this, the two countries agreed that "the power produced would be equally divided (…), each being granted the preferential right to acquire, at fair prices, any quantity of power not utilized by the other for its own consumption". The Itaipu Treaty of 1973 established Itaipu Binacional (jointly owned by ELETROBRAS (Brazil) and the Administración Nacional de Electricidad (Paraguay)), which built, owns and operates the facility. The treaty requires Itaipu Binacional to pay royalties to both governments, in equal portions, for the exploitation of the resources.

This case is also exceptional in that Brazilian law – following the new Constitution of 1988 – stipulates that, throughout the life of the infrastructure, 45 per cent of the royalties received by Brazil from Itaipu Binacional are to be shared with the municipalities affected by the project.

Sources: on the Kariba Dam: Klaphake / Scheumann (2009); Tumbare (2002); WCD (2000b); ZRA (1987); on the Itaipu Dam: Égré et al. (2002, 35–36); Égré (2007, 22–27); Scudder (2005)

2.6 Summary of the cases

Table 3 summarizes the cases presented in sections 2.1 to 2.5, showing their hydro-political constellations, incentive structures and benefit-sharing mechanisms. As discussed above, with the exception of the LHWP, the initial benefit-sharing mechanisms described in Table 3 did not take negative social and environmental effects adequately into account.

Table 3: Overview of cases

River / project	Hydro-political constellation and dam purposes	Incentive structure	Benefit-sharing mechanism
Manantali and Diama Dams on River Senegal (Senegal, Mali, Mauritania, Guinea)	(1) and (2): Upstream and downstream dams on transboundary river: hydropower, navigation, irrigation and flood control	(i) financial constraints on all riparans – project rational only collectively (ii) Senegal and Mauritania lack appropriate dam sites for hydropower	(A): Sharing of cost of jointly owned infrastructure in proportion to expected irrigation, navigation and hydropower benefits; OMVS attracts funding sources
Canadian dams on Columbia River (Canada, USA)	(1) upstream dams on transboundary river: hydropower and flood control	(ii) flood control benefits to USA; electricity gain for Canada	(B) increase in aggregate net benefits through altered dam design upstream: Canada builds dams for downstream flood control and upstream hydropower generation; USA compensates Canada for investment costs by paying half of the value of downstream flood protection and electricity generation
LWHP on River Senqu-Orange (Lesotho, South Africa)	(1) upstream dams on transboundary river: hydropower and water supply	(iii) increased water supply for South Africa; electricity gain for Lesotho	(C) South Africa pays investment and operating costs and external costs of storage and transfer of water from Lesotho; Lesotho receives in-kind hydropower benefits; net benefits of cooperation compared to unilateral action are shared (royalties)
Aswan High Dam on Nile River (Egypt, Sudan)	(2) downstream dam on transboundary river: hydropower and irrigation	negative externality upstream	none, but compensation
Kariba Dam on River Zambezi (Zambia, Zimbabwe) Itaipu Dam on Río Paraná (Brazil, Paraguay)	(4) dam on border river: hydropower	symmetrical benefits and externalities	(A) joint investment, benefit allocation according to investment shares

Source: authors' own compilation

3 Factors influencing benefit-sharing

3.1 Political and institutional factors

A number of factors play a role in whether benefit-sharing schemes materialize. As Phillips et al. (2006) aptly argue, the realization of benefit-sharing depends on the political environment in the basin. From our case studies we can identify the following intervening variables.

3.1.1 Foreign policies of relevant basin states

Cooperative foreign policies are likely to increase the willingness of basin countries to negotiate on the use of shared water resources, since states that cooperate have established channels of communication and platforms for acting together on a wide variety of issues. Incompatible foreign policies are likely to prevent cooperation, given the lack of mutual trust (see also LeMarquand 1977 and Frey 1993). The Columbia River Basin is a prime example, Canada's and the United States' cooperative policies reaching back into the 18th century (see also section 3.1.2 below). Vaz and van der Zaag (s. a.) have found that cooperation in the Incomati basin (not included in this study) increased as South Africa shifted its regional foreign policy from conflict to cooperation.

3.1.2 A history of cooperation between basin states and of institutionalized cooperation in the basin

The literature argues that, in river basins with a history of cooperation and institutions to build on, cooperation in new areas can be achieved more easily than in basins where no institutions exist (Wolf 2004), since existing mechanisms can be used to exchange information and build mutual confidence, which reduces transaction costs. However, it should be noted that in many river basins it took a long time for cooperation to emerge.

The countries adjoining the River Senegal had concluded multilateral agreements since the 1963 Bamako Convention, when the river was accorded international status. The aim was the economic exploitation of the river, which had first been attempted by the French colonialists. The 1963 agreement provided the basis for the 1972 OMVS agreement. By 1972, however, Guinea, a signatory to the Bamako Convention, had decided not to continue participating in the multilateral effort and did not return to the OMVS until 2005. It should also be mentioned that the history of cooperation did not prevent Senegal and Mauritania from engaging in a border war from 1989 to 1991: an attempt by an alliance of domestic actors in Mauritania to profit from the increase in land prices due to the irrigation project led directly to the conflict with Senegal (Kipping 2005).

By the time the Columbia River Treaty was concluded in 1961, negotiations on the transboundary rivers between the United States and Canada had been ongoing for roughly 200 years. The first agreement was signed in 1783, when the two countries laid down navigational rights for their citizens. Several other agreements followed, laying the foundations for the Columbia River Treaty. The history of cooperation is also testimony to the political will of both countries to resolve disputes peacefully.

Bilateral cooperation on the Kariba Dam began in the 1950s during the colonial period. Disagreements notwithstanding, the post-colonial states of Zambia and Zimbabwe were therefore in a relatively good position to continue negotiations on the basis of the colonial plans.

3.1.3 The nature of domestic administrative systems and power structures

The nature of domestic political institutions, that is, the relationship between state and society, determines decision-making processes (e. g. Le Marquand 1977). For example, in states where environmental non-governmental organizations are able to influence the decision-making process, policies may be more environmentally sensitive than in authoritarian countries, where governments may pursue an agenda of fast GDP growth, with less scope for opposition. Domestic decision-making processes in democratic states can be influenced by a host of stakeholders, including local governments, ministerial bureaucracies, political parties and such non-state actors as businesses, non-governmental organizations and policy entrepreneurs. The relative powers and capacities of these actors and the policy networks they form have a bearing on policies at national level. As mentioned above, international cooperation may therefore be described as a two-level game (Putnam 1988), in which the ratification of international agreements hinges on endorsement at national level.

If the communities directly affected have a voice and influence in decision-making at national level, international benefit-sharing projects on international rivers may be influenced by domestic actors' concerns about social and environmental issues.

For instance, Canada's federal system accords the provinces sovereign rights over the natural resources in their territories. Legislation allocates the provinces considerable decision-making power vis-à-vis the federal government. During the negotiations with the United States on the Columbia River Treaty, Canada therefore underwent a complex process of internal negotiation to find a common position from which to negotiate with the United States. This notwithstanding, the voices of local communities were only heard and a local benefit-sharing mechanism established more than 30 years after initial agreement has been concluded. In the case of the LHWP, the institutional set-up and the mechanism for compensating for social and environmental damage/effects were revised under domestic and international pressure, but remain controversial.

3.1.4 National water policies and preferences

National water policies, which reflect domestic policy discourses and preferences, also have a bearing on interstate cooperation (e. g. Waterbury 1997). Whether countries have adopted the concept of Integrated Water Resources Management (IWRM), how efficiently countries use their water resources or whether they have a preference for expanding irrigated agriculture determines their interests in the economic use of a river and the potential for conflict and cooperation with other basin states. National development objectives also determine dam functions (multi- or single-purpose) and design.

The complex *Clé de Répartition* between Mali, Mauritania and Senegal was the result of a compromise based on different national water-use preferences and policies. The United States' interest in protecting its hydropower production from floods and upstream Canada's plans also to produce hydropower led to the benefit-sharing mechanism in the Columbia River Treaty. The LHWP came about because of South Africa's perceived need to increase the supply of water to the Gauteng region.

If national policies opt for dams generating hydro-electricity, the potential for cooperation and for establishing benefit-sharing arrangements is high when compared with other dam-

related purposes (irrigation). If, on the other hand, countries achieve high water-use efficiency internally, they may see less need for international cooperation (Waterbury 1997).

3.1.5 Third parties

Bi- and multilateral donors and private enterprises may play an important role in the formulation of benefit-sharing mechanisms, because they provide funding and technical knowledge and can act as neutral intermediaries (Mostert 2005).

In the Senegal case, 16 donors supported the establishment of the OMVS, and several of them backed the creation of the Regional Hydropower Development Project, which mitigated environmental effects and helped to revive energy production at the Manantali Dam. However, the OMVS needed continued donor support to ensure sustained funding, the disadvantage of donor support thus being that organizations may come to rely on it.

Where a number of donors are involved, it will also be necessary to coordinate individual funding projects. If donors operate in the same river basin or sub-basin, the joint creation of benefit-sharing mechanisms can preclude the financing of rival projects or the duplication of funding.

3.1.6 Regional initiatives

Regional initiatives that extend beyond dam construction may be important for the establishment of benefit-sharing mechanisms. Where regional cooperation projects or wider regional economic integration frameworks (such as the SADC) exist, they can serve as a platform for the exchange of information and the building of mutual confidence and so reduce transaction costs (e. g. Durth 1996). Benefit-sharing mechanisms on shared rivers can therefore build on existing regional cooperation projects or on regional institutions.

What is particularly important in the SADC's case is that the revised SADC Protocol on Shared Watercourse Systems (2000) requires the member states to consult on the construction of water infrastructure. Additional SADC guidelines exist in the form of the Regional Water Policy, the Regional Water Strategy and the Regional Indicative Strategic Development Plan. Benefit-sharing in the SADC region therefore has the major advantage of a politically conducive environment and the accepted concept of regional development (SADC s. a., 2).

3.1.7 Power relations between riparian states

Power relations between riparian countries can play an important role in fostering or hindering cooperation. It can generally be assumed that symmetrical power relations are more conducive to cooperation and benefit-sharing than asymmetrical relations. In a large N study, Song and Whittington (2004) find that riparian countries with equal economic and political strength are far more likely to have negotiated treaties than other riparian countries.

In the case of the River Senegal, all three states had reached similar levels of economic development and therefore faced a similar development need to move from an agriculture-based to a more advanced industrialized economy. In the case of the Columbia River basin, benefit-sharing similarly profited from fairly symmetrical power relations.

On the other hand, asymmetrical power relations among riparian states may impede the application of benefit-sharing mechanisms, because the more powerful state lacks the incentive to cooperate (Zeitoun / Jägerskog 2011) even if net benefits would increase through cooperation. In the case of the Nile, for instance, Egypt decided in the 1950s to build a major dam on its own territory (the Aswan High Dam) in order to maintain full control over the project, even though it knew of the benefits of a transboundary approach that would have involved dam projects in Ethiopia (Waterbury 1979).

3.2 Processes: application of benefit-sharing during or after dam-building negotiations

In process terms, a benefit-sharing mechanism can be negotiated during the planning and construction phase or after the dam has been commissioned. In the latter case, the implementation of environmental management plans may be included to compensate for environmental effects not taken into account in the original planning of the dam; adjustments may be made to the operation of the dam in order to release additional water for the benefit of downstream agriculture; or electricity and water volumes may be reallocated to even out perceived imbalances in the distribution of benefits when the original agreements were concluded.

An example of this is the hydropower-generating Kariba Dam on the River Zambezi, planned during the CAPCO mandate. Zambia believed the dam was producing more benefits for Zimbabwe, and the dispute led to CAPCO's dissolution in 1985, the establishment of the Zambezi River Authority in 1987 and finally to a 50:50 allocation of costs and benefits (Mokorosi 2007).

Another example is the River Senegal project, where the riparian states changed the operation of the dam to create artificial flooding for more traditional agricultural production. In 2002 the riparians also signed a Water Charter to institutionalize environmental protection mechanisms in the OMVS.

In other projects, benefit-sharing applies right from the planning and construction phases. This is true, for example, of projects in which countries share the financial burden of planning and constructing the dam and then such beneficial outcomes as hydropower, irrigation water or flood control. Among the many projects of this kind are the Lesotho Highlands Water Project, the River Senegal and the Columbia River Treaty.

3.3 Net benefits: full accounting of social and environmental costs

One of the arguments advanced in the debate on dams is that, in too many cases, only a small segment of society benefits, while people living near the site of a dam have to endure its negative impacts: the flood control achieved with a dam may benefit those living downstream, while the assets of those living in or near the area reserved for the reservoir

disappear beneath the water; reservoirs store water for irrigation to the benefit of a group of people downstream, but at a high cost for those living in the reservoir area; power generation benefits urban centres and industry, sometimes at some distance from the dam site, but not necessarily those living nearby; and people living close to the reservoir may also have to endure such adverse environmental or health effects as eutrophication of a reservoir and waterborne diseases.

This list is not exhaustive, but it indicates that those subject to involuntary resettlement have a heavy burden to bear. The estimated number of people involuntarily resettled from dam sites worldwide is far from insignificant, ranging between 40 and 80 million (WCD 2000a, 11), many of whom have yet to be fully compensated for their losses.

Basic requirements for the construction of socially and environmentally friendly dams are recommended, for example, by the World Commission on Dams (WCD 2000a) and the Safeguard Policies of the World Bank (2001), which address involuntary resettlement practices and environmental planning and management. Both policies call not only for compensation for the loss of land and other property but also for the creation of new income-generating opportunities, for the restoration of the livelihoods of the populace affected (Pearce 1999) and for the costs of environmental management plans to be covered.

To prevent benefits from being shared between states at the expense of those who live near a dam, the mitigation of the adverse effects of a dam project on a transboundary or border river is a cost component which should be taken fully into account when net benefits are calculated.

There are monetary and non-monetary mechanisms that do more than compensate for environmental and economic losses. They are means of sharing some of the benefits gained from dam operation (Égré et al. 2002, 2) with all those affected – to varying degrees – by the project. Funds for local or regional development, for instance, are derived from the revenue stream of the project when in operation (Haas 2009).

The World Bank (Égré et al. 2002) and the UNEP Dams and Development Project (2007) reviewed compensation options in dam projects on international, transboundary and national rivers and identified a number of monetary and non-monetary mechanisms:

- Redistributing some of the dam revenues to local/regional authorities in the form of royalties tied to power generation or water charges;
- Establishing development funds financed from power sales to provide, for example, seed money for economic development in the project-affected area;
- Part or full ownership of the project by project-affected people who share profits (and risks);
- Levying property taxes on dam owners (e. g. hydropower corporations) or on a dam's property value (taxes are not related to revenues generated, but are a fixed charge) which are then transferred to local authorities, communities affected or river basin authorities;
- Granting preferential electricity rates and subsidized irrigation water to local companies and project-affected populations;
- Allocating fishing rights to resettlers in the newly created reservoir and hiring project-affected people for construction works (Égré et al. 2002, 3).

A prominent example is the regulation in Brazil: Brazilian law stipulates that States and municipalities affected must receive a percentage of the royalties from Itaipu Binacional, the owner and operator of the Itaipu Dam on the Río Paraná. In Paraguay, on the other hand, 100 percent of the royalties are paid into the national treasury, which then decides on their redistribution. In Canada the Columbia Basin Trust, which represents 170,000 residents of the Columbia Basin, receives a share of the revenue from hydroelectricity generation which the USA pays in exchange for the prevention of flooding downstream achieved with the help of the dam on Canadian territory. If really and effectively implemented, such schemes have the potential to increase the domestic acceptability of dam projects on shared rivers and so to alleviate any negative effects of applying interstate benefit-sharing mechanisms.

4 Conclusions and recommendations for development cooperation

This study has explored incentive structures and mechanisms for sharing the benefits of dams on shared rivers. It posits that the opportunities for deriving benefits from cooperation depend on the alignment of hydrological and political boundaries and the location of the dam in relation to them ('hydro-political constellations') and on the aims and external effects of each dam. It has been argued that it is rational for riparians to cooperate if each is able to generate higher aggregate net benefits than it would attain without cooperation. In doing so negative social and environmental effects should be fully taken into account and compensated. Cases identified in this study in which the benefits of cooperating on dams have been shared include the dams on the River Senegal, the Canadian dams on the Columbia River, the Lesotho Highlands Water Project on the River Orange-Senqu, the Kariba Dam on the River Zambezi and the Itaipu Dam on the Río Paraná. These cases represent the following four incentive structures for cooperation on dams on shared rivers:

- cooperation enables economic or financial constraints on unilateral action to be overcome (River Senegal),
- an altered dam design upstream increases net aggregate benefits (Columbia River),
- locating a dam upstream increases aggregate net benefits (River Orange-Senqu),
- a joint dam on a border river enables mutual benefits to be achieved (River Zambezi, Río Paraná).

The case studies also represent three different types of benefit-sharing mechanisms: (A) costs are shared in relation to benefits in the case of jointly owned dams (River Senegal, River Zambezi, Río Paraná); (B) the party altering its unilateral dam design is compensated for losses incurred as a result of this alteration, and net benefits of cooperation are shared (Columbia River); and (C) the downstream state convinces the upstream state to build a dam, covers the cost and shares the net benefits of the dam (River Orange-Senqu). Benefit-sharing seems to be particularly straightforward where the riparians decide to co-own the infrastructure involved from the outset. The costs are then shared in proportion to benefits (Type A). Interestingly, this happens not only on border rivers, the River Senegal being an example where it has occurred on a transboundary river.

While benefits have been shared in these cases, it is also evident that, in many cases, the environmental and social impacts on the population affected by dams were not taken into account from the outset, and projects had to be renegotiated at a later stage. It should be

pointed out that some of the projects concerned were negotiated several decades ago and, to our knowledge, they were not conceived as 'benefit-sharing' projects. Furthermore, even if benefits of cooperation can be identified and cooperation therefore appears rational for all riparians, a number of factors in the political and institutional environment influence the application of a benefit-sharing approach to dams.

The study has also failed to find any evidence of benefit-sharing where negative externalities occur upstream. In the case of the Aswan High Dam on the Nile, the downstream riparian, Egypt, provided some compensation for resettlement in Sudan upstream, but it is questionable whether this can be described as benefit-sharing.

From a scientific point of view, the typology developed should be tested further in additional case studies. Some of the cases studied would also merit more in-depth research to answer a number of open questions concerning the benefit-sharing and compensation mechanisms used (e. g. the Nile and Columbia cases).

On the basis of these findings, donors may support the application of benefit-sharing schemes if they remember that the precise opportunities and incentives for benefit-sharing in the construction of dams on shared rivers depend on the particular interests of the parties involved and on the opportunities presented by the given hydro-political setting. Our recommendations are as follows.

Recommendation 1

If the potential inherent in river dams for economic and social gains and for mitigation and adaptation in relation to climate change is to be exploited, benefit-sharing at international level should become a prioritization criterion for donors in their decisions on whether or not to support such projects. Benefit-sharing is an approach to precluding upstream-downstream conflicts on a shared river, and it is in line with the principles of international water law.

Recommendation 2

Donors should seize windows of opportunity and help riparian countries to identify benefit-sharing potential (that is, explore project options; define baskets of benefits for multipurpose dams; support cost-benefit analysis) and appropriate mechanisms. Ideally, this would be done in a quantitative manner, but a useful first step might be to analyse certain benefit streams in a qualitative way, since monetizing some of the benefits may be very difficult.

Recommendation 3

Donors should help relevant actors with capacity development and enable them to develop and implement benefit-sharing mechanisms; these actors are a diverse group, comprising, for example, national water and energy administrations, river basin organizations, regional economic organizations and power utilities.

Recommendation 4

Donor financing of regional benefit-sharing mechanisms should be provided only if social and environmental costs are fully compensated for and taken into account in calculating net benefits. Donors should also ensure that riparian countries contribute towards infrastructure development. The cost components of adequate resettlement planning, environmental management and cultural heritage plans should be calculated on the basis of international standards and impact assessment studies (environmental, social), which should be applied in a transboundary context (see UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and the UNECE Convention on Access to Justice in Environmental Matters (Aarhus Convention)).

Recommendation 5

Donors should support the re-negotiation of benefit-sharing at existing dams if requested to do so by the parties concerned.

Aside from these specific recommendations, which concern the examination and implementation of benefit-sharing schemes, there are others relating to support for the development of an environment conducive to benefit-sharing. The rationale is that benefit-sharing is not merely a technical and rational economic process. Political factors, such as national foreign policy preferences, domestic administrative systems and power structures and national water policies, are likely to play a part in negotiations on benefit-sharing schemes.

Recommendation 6

Donors should support the adoption/ratification of international agreements and regional water treaties by the riparian countries concerned in order to promote transboundary water cooperation. International water treaties (such as the 1997 Convention on the Law of the Non-Navigational Uses of International Watercourses) or regional treaties (such as the 2000 SADC Protocol on Shared Watercourses and the Helsinki Convention, 1992) lay down general principles for equitable and reasonable utilization and the avoidance of significant harm on shared rivers and thus provide guidance on the cooperative use of shared rivers.

Recommendation 7

Donors should support the reform of national water policies with a view to the adoption of Integrated Water Resources Management (IWRM) principles. National water policies that are in line with IWRM and promote the efficient, environmentally sustainable and socially acceptable use of water resources are likely to be more conducive to the cooperative use of those resources at transboundary level.

Recommendation 8

Donors might support regional initiatives extending beyond water, since they can serve as platforms for the exchange of information and the harmonization of national development objectives. Embedding planning in a regional initiative also enables existing cooperation mechanisms to be used and ensures that the planning of a dam is linked directly to other regional initiatives (such as the promotion of the interconnection of hydropower systems).

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